IN THE SPECIFICATION:

Please amend paragraph **[0005]** as follows:

[0005] State-of-the-art backgrinding processes are useful for reducing the thicknesses of ~~200mm~~ 200 mm diameter silicon wafers, which are typically about ~~728μm~~728 μm thick, and ~~300mm~~ 300 mm diameter wafers, which are typically about ~~800μm~~800 μm thick, to as thin as about ~~50μm~~50 μm. When the thickness of a semiconductor substrate is reduced, however, the semiconductor substrate becomes less robust. For example, when the thickness of a ~~200mm~~ 200 mm diameter silicon wafer is reduced to about ~~230μm~~230 μm or less, it becomes pliable and is prone to sagging when positioned on an edge or when an edge thereof is handled. As a consequence of the reduced robustness of thinned semiconductor substrates, the semiconductor devices that have been fabricated thereon are more likely to be damaged when thinned semiconductor substrates are handled or packaged.

Please amend paragraph **[0013]** as follows:

[0013] Additionally, the present invention includes methods for thinning and processing semiconductor substrates while support structures that incorporate teachings of the present invention are secured to active surfaces thereof. The present invention also includes methods for removing support structures of the present invention from semiconductor substrates.

Please amend paragraph **[0037]** as follows:

[0037] Alternatively, although not shown in the drawings, semiconductor substrate 10 may lack semiconductor devices 24 on interior section 22 of active surface 12 thereof. This is because it may be desirable to thin a semiconductor substrate 10 prior to fabricating structures, such as semiconductor devices, thereon or therefrom. For example, the loss of semiconductor devices and the expenses incurred in fabricating the same may be avoided if a thinned semiconductor substrate 10″ (FIG. 14B) without any semiconductor devices thereon breaks or is otherwise damaged during the thinning process. Alternatively, one entity may thin semiconductor substrates 10, then ~~provided~~ provide the thinned semiconductor substrates 10″ to one or more other entities for further processing (*e.g.*, device fabrication).

Please amend paragraph **[0039]** as follows:

[0039] Turning now to FIGs. 2 through 4B, an example of a support structure according to the present invention, in this case a support ring 40, 40′, 40a′, 40b′, 40c′ (shown in FIGs. 3, 4A, 4B, 4C, and 4D, respectively) is depicted. As shown, support ring 40, 40′, 40a′, 40b′, 40c′ is positioned on active surface 12 of semiconductor substrate 10, over edge bead removal area 20 thereof. Support ring 40, 40′, 40a′, 40b′, 40c′ extends completely ~~along~~ around an outer periphery 13 of active surface 12.

Please amend paragraph **[0040]** as follows:

[0040] An outer peripheral edge 42, 42′ of support ring 40, 40′, 40a′, 40b′, 40c′ is in substantial alignment with (FIG. 3) or is located outside (FIGs. 4A and 4B) of outer ~~periphery~~ peripheral edge 18. An interior edge 44 of support ring 40, 40′, 40a′, 40b′, 40c′ defines surfaces of an aperture 45 through support ring 40, 40′, 40a′, 40b′, 40c′. Interior section 22 of active surface 12 and, thus, all of the semiconductor devices 24f thereon are completely surrounded by ~~an~~ interior ~~peripheral~~ edge 44 of support ring 40, 40′, 40a′, 40b′, 40c′ and exposed through aperture 45 thereof.

Please amend paragraph **[0041]** as follows:

[0041] Support ring 40, 40′, 40a′, 40b′, 40c′ is formed from a material that is compatible with the material or materials of semiconductor ~~substrate~~substrate 10. The material of support ring 40, 40′, 40a′, 40b′, 40c′ will, along with the thickness of support ring 40, 40′, 40a′, 40b′, 40c′, ~~40b′, 40c′,~~ impart a thinned semiconductor substrate 10″ (FIG. 14B) with the desired amount of rigidity. For example, it may be desirable to impart a thinned semiconductor substrate 10″ with approximately the same amount of rigidity as that of the semiconductor substrate 10 prior to thinning thereof. As another example, it may be desirable to impart a thinned semiconductor substrate 10″ with sufficient rigidity to prevent bending, sagging, or other nonplanarity thereof during processing or transportation thereof following the thinning process.

[0042] In addition, the material from which support ring 40, 40′, 40a′, 40b′, 40c′ is formed may be substantially impervious to chemicals (*e.g.*, wet and dry etchants) that may be used in backgrinding processes, as well as compatible with conditions of any post-thinning ~~or~~ processes.

Please amend paragraph **[0044]** as follows:

[0044] It is also desirable to form support ring 40, 40′, 40a′, 40b′, 40c′ from a material that has a coefficient of thermal expansion (CTE) that is as close as possible to that of the material or materials from which semiconductor substrate 10 is formed (*e.g.*, silicon has a CTE of about 2.9×10^{-6}/° C.), thereby preventing warpage of semiconductor substrate 10 and delamination of support ring 40, 40′, 40a′, 40b′, 40c′ therefrom during processing of semiconductor ~~substrate~~ substrate 10 (*e.g.*, thinning or any processing that occurs thereafter).

Please amend paragraph **[0046]** as follows:

[0046] Along with the materials from which support ring 40, 40′, 40a′, 40b′, 40c′ is formed, the dimensions or configuration thereof may provide the desired properties. For example, as illustrated in FIGs. 3 through 4D, a support ring 40, 40′, 40a′, 40b′, 40c′ according to the present invention may have a width W which is at least as great as the width of edge bead removal area 20 (*i.e.*, typically about ~~3mm~~ 3 mm or more).

Please amend paragraph **[0047]** as follows:

[0047] In another example, with continued reference to FIGs. 3 through 4D, the height H of support ring 40, 40′, 40a′, 40b′, 40c′ may impart support ring 40, 40′, 40a′, 40b′, 40c′ and, thus, a thinned semiconductor substrate 10″ (FIG. 14B) with which support ring 40, 40′, 40a′, 40b′, 40c′ is to be used with a desired amount of rigidity. For example, depending, of course, upon the rigidity and CTE of the material from which support ring 40, 40′, 40a′, 40b′, 40c′ is formed, support ring 40, 40′, 40a′, 40b′, 40c′ may have a height of as small as about ~~25μm~~25 μm (one mil) to about ~~200μm~~200 μm (eight mils) or greater.

Please amend paragraph **[0048]** as follows:

[0048] When a thinned semiconductor substrate 10″ and a support ring 40, 40′, 40a′, 40b′, 40c′ thereon will be handled or processed with equipment which is configured to handle and process semiconductor substrates of standard diameters and thicknesses, the combined height H of support ring 40, 40′, 40a′, 40b′, 40c′ and thickness of a thinned semiconductor substrate 10″ (FIG. 14B) should not exceed the maximum substrate thickness (*e.g.*, about ~~800μm~~800 μm) that such equipment is configured to accommodate. Likewise, the outer diameter (OD) of support ring 40, 40′, 40a′, 40b′, 40c′ should not exceed the maximum substrate diameter (*e.g.*, ~~200mm, 300mm~~200 mm, 300 mm, etc.) that equipment for handling or processing a thinned semiconductor substrate 10″ may be configured to accommodate.

Please amend paragraph **[0050]** as follows:

[0050] Alternatively, as depicted in FIG. 4A, a support ring 40′ may extend beyond outer peripheral edge 18 of semiconductor substrate 10, with an outer peripheral edge 42′ of ~~a~~ ~~support~~support ring 40′ being positioned outside of outer peripheral edge 18 of semiconductor substrate 10. Accordingly, support ring 40′ includes an overhang region 46′, which is located beyond outer peripheral edge 18 of semiconductor substrate 10. Please amend paragraph **[0039]** as follows:

Please amend paragraph **[0051]** as follows:

[0051] In addition, support ring 40′ may include a circumferential support element 48′ beneath overhang region 46′, substantially coplanar with semiconductor substrate 10, and in substantial contact with outer peripheral edge 18. Circumferential support element 48′ may have a height which is about the same as or less than the desired thickness of semiconductor substrate 10 following thinning thereof (*i.e.*, the thickness of thinned semiconductor substrate 10″ ~~(FIG. 14B)~~(FIG. 14B)).

Please amend paragraph **[0054]** as follows:

[0054] ~~As shown in FIG. 4C,~~Shown in FIG. 4C is another variation of support ring 40b', which includes all of the features of support ring 40' (FIG. 4A). Support ring 40b' differs from support ring 40' in that circumferential support element 48b' of support ring 40b' extends from overhang region 46' substantially to, as shown, or beyond a plane in which back side 16 of semiconductor substrate 10 is located.

Please amend paragraph **[0057]** as follows:

[0057] As shown in FIGs. 5 and 6, another variation of support ring 40" may comprise one or more sealing elements 50" which protrude from an upper surface 49" of support ring 40". FIGs. 5 and 6 depict support ring 40" as including three concentrically arranged sealing elements 50", although support rings 40" with other numbers (*i.e.*, as few as one or more than three) of sealing elements 50" are also within the scope of the present invention. Sealing elements 50" are somewhat compliant features that are configured to facilitate the creation of a seal between upper surface 49" of support ring 40" and a surface or feature (not shown) against which support ring 40" is to be positioned, such as a surface of ~~sealing~~ a sealing ring of a vacuum chuck.

Please amend paragraph **[0058]** as follows:

[0058] Features of other embodiments ~~support~~ of support structures according to the present invention, which are referred to herein as "support members" 140, 140', are pictured in FIGs. 7 through 9. In addition to including an outer peripheral portion 150, 150' that covers an edge bead removal area 20 of active surface 12 of semiconductor substrate 10, support member 140, 140' also includes an interior portion 160, 160' that forms protective structures 28, 28' over semiconductor devices 24f that are carried by interior section 22 of active surface 12.

Please amend paragraph **[0059]** as follows:

[0059] As FIGs. 8 and 9 illustrate, outer peripheral portion 150, 150′ of support member 140, 140′ may be configured substantially the same as support rings 40, 40′ depicted in ~~FIGs. 3 and 4~~FIGs. 3 and 4A, respectively. In addition, although not illustrated, outer peripheral portion 150, 150′ of support member 140, 140′ may include one or more sealing elements, such as the sealing elements 50″ that are shown in FIGs. 5 and 6.

Please amend paragraph **[0061]** as follows:

[0061] FIG. 9 shows a semiconductor substrate 10′ which includes trenches 32 at the locations of streets 30, material of streets 30 having been removed by known processes, such as partial cutting with a wafer saw, photolithography (*e.g.,* mask) and etch processes, or the like, to form trenches 32. Thus, protective structure 28′ covers an active surface 26 of each corresponding semiconductor ~~device 24~~device 24f, as well as at least a portion of peripheral edges 25 thereof.

Please amend paragraph **[0064]** as follows:

[0064] In addition, since support members 140, 140′ ~~including~~ include protective structures 28, 28′, the material from which support members 140, 140′ also provides other desirable properties, such as a particular level of electrical insulation, an ability to withstand subsequent processing conditions (*e.g.,* dicing, further packaging, ~~etc.)~~etc.), an ability to withstand operating conditions (*e.g.,* temperature) to which each semiconductor device 24f is subjected when in use, a particular degree of impermeability to moisture, or the like.

Please amend paragraph **[0067]** as follows:

[0067] In FIG. 10, an example of a stereolithography system 1000, which effects a type of layered manufacturing process that employs selective irradiation of radiation-curable (*e.g.,* ~~ultraviolet,~~by ultraviolet light, etc.) curable resin, is schematically represented.

Please amend paragraph **[0071]** as follows:

[0071] Fabrication tank 1100 may also have a reservoir 1120 associated therewith. Reservoir 1120 may be continuous with chamber 1110. Alternatively, reservoir 1120 may be separate from~~,~~ but communicate with chamber 1110 in such a way as to provide unconsolidated material 1126 thereto. Reservoir 1120 is configured to at least partially contain a volume 1124 of unconsolidated material 1126, such as a photoimageable polymer, or "photopolymer," particles of thermoplastic polymer, resin-coated particles, or the like.

Please amend paragraph **[0072]** as follows:

[0072] Photopolymers believed to be suitable for use with a stereolithography ~~apparatus 10~~system 1000 and for fabricating support structures, such as support rings 40′, in accordance with teachings of the present ~~invention~~ invention, include, without limitation, Cibatool SL 5170, SL 5210, SL 5530, and SL 7510 resins. All of these photopolymers are available from Ciba Specialty Chemicals Inc. of Basel, Switzerland.

Please amend paragraph **[0074]** as follows:

[0074] A material consolidation system 1200 is associated with fabrication tank 1100 in such a way as to direct consolidating energy 1220 into chamber 1110 thereof, toward at least areas of surface 1128 of volume 1124 of unconsolidated material 1126 within reservoir 1120 that are located over semiconductor substrate 10. Consolidating ~~energy 1200~~energy 1220 may comprise, for example, electromagnetic radiation of a selected wavelength or a range of wavelengths, an electron beam, or other suitable energy for consolidating unconsolidated material 1126. Material consolidation system 1200 includes a source 1210 of consolidating energy 1220. If consolidating energy 1220 is focused, source 1210 or a location control element 1212 associated therewith (*e.g.*, a set of galvanometers, including one for x-axis movement and another for y-axis movement) may be configured to direct, or position, consolidating energy 1220 toward a plurality of desired areas of surface 1128. Alternatively, if consolidating energy 1220 remains relatively unfocused, it may be directed generally toward surface 1128 from a single, fixed location or from a plurality of different locations. In any event,

operation of source 1210, as well as movement thereof, if any, may be effected under the direction of controller 1700.

Please amend paragraph **[0077]** as follows:

[0077] Cleaning component 1400 of stereolithography system 1000 may also operate under the direction of controller 1700. Cleaning component 1400 of stereolithography system 1000 may be continuous ~~with a~~with chamber 1110 of fabrication tank 1100 or positioned adjacent to fabrication tank 1100. If cleaning component 1400 is continuous with chamber 1110, any unconsolidated material 1126 that remains on a semiconductor substrate 10 may be removed therefrom prior to introduction of another semiconductor substrate 10 into chamber 1110.

Please amend paragraph **[0079]** as follows:

[0079] Material reclamation system 1500 collects excess unconsolidated material 1126 that has been removed from a semiconductor substrate 10 by cleaning ~~system~~ component 1400, then returns the excess unconsolidated material 1126 to reservoir 1120 associated with fabrication tank 1100.

Please amend paragraph **[0083]** as follows:

[0083] Next, as shown in FIG. 11B, support platen 1112 is raised such that the upper surface of semiconductor substrate 10 is brought to about the same level as (*i.e.*, coplanar with) surface 1128, as shown, or above surface 1128 of volume 1124. Areas 1129 of unconsolidated material 1126 that are located adjacent to outer peripheral edge 18 of semiconductor substrate 10 are then at least partially selectively consolidated (*e.g.*, with a laser or other focused consolidating energy 1220) to initiate the formation of circumferential support element 48′ (FIGs. 4A and 11C) of support ring 40′ (FIG. 4A). This process may be effected ~~once,~~once if circumferential support element 48′ comprises a single material layer, or repeated multiple times, lowering semiconductor substrate 10 in multiple increments until active surface 12 thereof is substantially planar with surface 1128 of volume 1124, if circumferential support element 48′ includes a plurality of superimposed, contiguous, mutually adhered layers of material.

Please amend paragraph **[0086]** as follows:

[0086] Following the fabrication of a support structure, such as support ring 40′, on semiconductor substrate 10, support platen 1112 may be raised such that at least semiconductor substrate 10 and the support structure (*e.g.*, support ring 40′) carried thereby are removed from volume 1124 of unconsolidated material 1126, as shown in FIG. 11E. Thereafter, semiconductor substrate 10 and the support structure thereon may be cleaned, as known in the art.

Please amend paragraph **[0089]** as follows:

[0089] As shown in FIG. 12A, semiconductor substrate 10 is positioned within a support cavity 212 of or otherwise supported by a first half 210 of a mold 200, with active surface 12 of semiconductor substrate 10 remaining exposed. Thereafter, a second half 220 of mold 200 is then positioned over active surface 12. Regions of active surface 12, including edge bead removal area 20 thereof, upon which the support structure (*e.g.*, support ring 40′) is to be ~~positioned~~ positioned, communicate with one or more cavities 222 of second half 220. Of course, first and second halves 210, 220 of mold 200 may include other features (*e.g.*, runners, vents, etc.) that are positioned appropriately for the type of molding process in which mold 200 is to be used.

Please amend paragraphs **[0094]** as follows:

[0094] Once preformed sheet 300 has been laminated to active surface 12, subtractive processes may be used to form a support structure according to the present invention therefrom, as shown in FIG. 13B. For example, and not to limit the scope of the present invention, a support structure (*e.g.*, support ring 40) may be formed by the use of photolithography processes to form a ~~mask~~ mask 310 and removal of material through ~~apertures~~ apertures 312 in ~~the~~ ~~mask~~mask 310 (*e.g.*, with an etchant or solvent that is suitable for use in removing the material of preformed sheet 300), photoablation (*e.g.*, which is useful with polymer films), or otherwise, as known in the art and suitable for use with the material of preformed sheet 300 and with semiconductor substrate 10 and semiconductor devices 24 (FIGs. 1 and 2) that have been

fabricated on active surface 12 thereof. ~~The mask~~Mask 310 may then be removed by way of known resist strip processes.

Please amend paragraph **[0095]** as follows:

[0095] Of course, combinations of processes for forming support structures that incorporate teachings of the present invention are also within the scope of the present invention. For ~~example~~ example, a support ring 40, 40′, 40a′, 40b′, 40c′, 40″ may be formed separately from a semiconductor substrate 10 (FIG. 1), in one or more pieces (*e.g.,* support ring 40c′ may be formed in two or more pieces), then assembled with semiconductor substrate 10 (and, in the case of support ring 40c′, pieces are assembled with one another) and secured (*i.e.,* adhered) thereto (and, in the case of support ring 40c′, secured to one another), such as by stereolithography processes or with an uncured polymer (*e.g.,* thermoset polymer or photopolymer) which is subsequently cured by exposure to radiation or heat.

Please amend paragraph **[0096]** as follows:

[0096] Turning now to FIGs. 14A and 14B, thinning of back side 16 of semiconductor substrate 12 is schematically depicted. Although FIGs. 14A ~~through 14C~~and 14B illustrate backgrinding of a semiconductor substrate 10 that includes a support ring 40 on at least active surface 12 thereof, backgrinding may also be effected with another embodiment of support structure of the present invention on at least active surface 12, as well as with another embodiment of semiconductor substrate (*e.g.,* semiconductor substrate 10′, shown in FIG. 9).

Please amend paragraph **[0097]** as follows:

[0097] As shown in FIG. 14A, semiconductor substrate 10 is positioned active surface 12-down over a carrier 400, for example, a vacuum chuck available from Semitool, Inc. of Kalispell, Montana. The support structure (*e.g.,* support ring 40) on active surface 12 of semiconductor substrate 10 contacts a surface 410 of carrier 400 or ~~corresponding~~ a corresponding feature (*e.g.,* an o-ring 412) thereon, and may form a seal thereagainst. Known processes (*e.g.,* application of a negative pressure N to active surface 12 of semiconductor

substrate 10) may be used to secure semiconductor substrate 10 against surface 410 or a feature (*e.g.*, o-ring 412) thereon and, optionally, to seal active surface 12 from exposure to conditions that are present at the exterior (*e.g.*, back side 16 and outer peripheral edge 18) of semiconductor substrate 10.

Please amend paragraph **[0098]** as follows:

[0098] Once semiconductor substrate 10 has been secured to carrier 400, known techniques may be used to remove material from back side 16 of semiconductor substrate 10 and, thus, to thin semiconductor substrate 10 to a desired thickness, as depicted in FIG. 14B. By way of example only, known mechanical backgrinding or polishing processes (*e.g.*, mechanical lapping techniques), chemical backgrinding or polishing processes (*e.g.*, wet etch processes, dry etch processes, such as that described in U.S. Patent 6,498,074 to Siniaguine et al., the disclosure of which is hereby ~~incorporated~~ incorporated herein in its entirety by this reference, etc.), or a combination of mechanical and chemical backgrinding or polishing processes may be employed to thin semiconductor substrate 10. Such thinning processes may be effected until the resulting thinned semiconductor substrate 10″ has a desired thickness (*e.g.*, a thickness of about ~~230μm~~ 230 μm or less, a thickness of about 50 μm or less, ~~etc.)~~etc.).

Please amend paragraph **[0100]** as follows:

[0100] FIG. 15 schematically depicts thinned semiconductor substrates 10″ of the present invention in substrate cartridges 510 of a multi-substrate cassette 500. As shown, cassette 500 includes a plurality of substrate cartridges 510, each of which is somewhat horizontally oriented and configured to receive a semiconductor substrate of standard dimensions (*e.g.*, a ~~200mm~~ 200 mm or ~~300mm~~ 300 mm silicon wafer that has not been thinned). Substrates, including thinned semiconductor substrates 10″ that incorporate teachings of the present invention, may be introduced into and removed from substrate cartridges 510, as known in the art (*e.g.*, with robotic handling equipment).

Please amend paragraph **[0105]** as follows:

[0105] As shown in FIG. 17A, known dicing processes (*e.g.*, the depicted wafer saw 600, a laser, etc.) may be used to singulate semiconductor devices 24f from thinned semiconductor substrate 10″. Since support ring 40, 40′, 40″ does not cover any of the semiconductor devices 24f that are carried by active ~~surface 12~~surface 12′ of thinned semiconductor substrate 10″, support ring 40, 40′, 40″ will remain on the fragments 124p′ that result from the dicing process, with each of the resulting semiconductor dice 124′ being substantially bare (*e.g.*, active surfaces 12′ thereof remaining exposed).

Please amend paragraph **[0106]** as follows:

[0106] Referring now to FIG. 17B, when the support structure comprises a support structure (*e.g.*, support member 140) that includes an interior portion (*e.g.*, interior portion 160) that covers portions of the active surfaces 12′ of semiconductor devices 24f, dicing, or singulation, of the semiconductor devices 24f from one another proceeds through both the interior portion and thinned semiconductor substrate 10″. The result of such dicing, or singulation, is a plurality of ~~low-profile~~low-profile packaged semiconductor ~~devices 123~~devices 123′.

Please amend paragraph **[0107]** as follows:

[0107] FIG. 17C illustrates dicing, or singulation, of a thinned semiconductor substrate 10′ that includes trenches 32 along streets 30 between adjacent semiconductor devices 24f, as well as a support member 140′ substantially covering active surfaces 12′ thereof. As shown, during the thinning process, trenches 32 and material of protective structures 28′ may be exposed through back side 16 of semiconductor substrate 10′, effectively separating semiconductor devices 24f from one another. Nonetheless, protective structures 28′, which comprise portions of interior portion 160′ of support member 140′, remain connected to one another, preventing the physical separation of semiconductor devices 24f from each another. Support member 140′ may be diced, or singulated, as known in the art, such as by use of the illustrated wafer saw 600. When the blade or blades 602 of wafer saw 600 are narrower than the

distance across trenches 32, peripheral edges 125 of each singulated semiconductor die 124′ will be at least partially covered with peripheral portions 129′ of singulated protective structures 128′, each of these elements together forming a ~~low profile~~low-profile packaged semiconductor device 123′.